Path Analysis Risk Factors that Influence Maternal Mortality in District of Brebes

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ABSTRACT

Background: Maternal mortality is one of health indicators of a country. Based on demographic and health survey in Indonesia in 2012, the data presented the fact that there was a significant increase on maternal mortality which was 359 maternal mortality in every 100,000 live births. Maternal mortality rate indicated a decrease to 305 maternal mortality in every 100,000 live births which was stated as a finding in Intercensal Population Survey in 2015. District of Brebes was one of the districts in the province of Central Java which had the highest maternal mortality in 2016 which was 54 maternal mortality. This study aimed to reveal the risk factors that influence maternal mortality.
Subjects and Method: This was an analytic observational study with case control design. This study was conducted in Brebes District, Central Java, from February to March 2017. A sample of 162 subjects, consisting of 54 cases of all mothers who died as part of Maternal Mortality Rate in District of Brebes during 2016, and were recorded in District of Brebes' Health Institutions, Central Java and 108 controls subjects were taken from cohort registry and verbal autopsy documents at the Community Health Centre whereby a case of maternal mortality existed, were selected in this study by fixed disease sampling. The dependent variables were maternal mortality, and the independent variables were maternal education, maternal job, numbers of visits to Antenatal Clinic (ANC), birth attendant, place of delivering babies, high-risk pregnancy, obstetric complications. The data were analyzed by path analysis model.
Results: The results of this research indicated that the risk factors which directly influenced maternal mortality were the amount of visits to ANC< 4 times (b= 0.25; 95% CI= 0.07 to 0.42; p= 0.006) and obstretical complications (b= 1.78; 95% CI= 1.85 to 0.14; p= 0.013). High level of education (b= -0.63; 95% CI= -0.91 to 0.34; p= 0.001) and maternal jobs (b= 1.00; 95% CI = 0.34 to 1.67; p= 0.003) were influenced their numbers of visits to ANC.
Conclusion: Amount of visits to ANC < 4 times and obstretical complications are influenced maternal mortality. High level of education and maternal jobs are influenced their numbers of visits to ANC.

Keywords : maternal mortality, risk factors, case control, path analysis

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BACKGROUND

Mother and child are family members who need priority in organising health efforts because mother and child are the susceptible group to family conditions and their general surroundings. Therefore, the assessments for mother and child's health status and performance of health efforts are important to do. Some of the success of mothers' health efforts can be assessed from the indicator of Maternal Mortality Rate (MMR). MMR is the numbers of mother deaths during pregnancy, labour and postnatal periods, or their treatments excluding other causes such as accidents, falls etc. per 100,000 live births (Kemenkes RI, 2016).

Over 25 years, world MMR decreased from 532,000/100,000 Live Births (Live

Births) to 303,000/100,000 LB. Thus, until 2015, as much as 830 women died during pregnancies, labours and postnatal periods. 99% of maternal mortality happened in developing countries (WHO, 2015). In 2016, one of the districts in Central Java with the highest maternal mortality was the District of Brebes, which recorded up to 54 events. (Dinas Kesehatan Propinsi Jawa Tengah, 2016).

McCathy dan Maine (1992) stated 3 influencial factors to maternal mortality: 1) proximate determinants which are the condition of and obstetric complications, 2) intermediate determinants which are the mother's health status, reproduction status, acsess to medical services, health care behaviour/ the use of health services and other unknown factors, 3) contextual determinants which include socio-cultural and economic factors, such as a female's status in a family and society, and a family status in society (Fibriana, 2007).

This research aims to reveal the risk factors that influence maternal mortality in District of Brebes, Central Java which includes proximate determinants, contextual determinants and intermediate determinants.

SUBJECTS AND METHOD

This research was observational analitical with case control study. The dependent variable was maternal mortality, and independent variables were maternal education, numbers of visit to ANC, birth attendants, places to deliver babies, high-risk pregnancy and maternal obstetric complications.

This research took place at the District of Brebes, Central Java because it was a district with the highest numbers of Maternal Mortality Rate (MMR) in the Province of Central Java.

The samples were taken in this research using a technique of fixed disease sampling. This technique took samples on labouring and postnatal mothers who died as cases, and labouring mothers who lived through the end of postnatal periods as controls. The cases in this research were all mothers who died as part of Maternal Mortality Rate in District of Brebes during 2016, and were recorded in District of Brebes' Health Institutions, Central Java. The numbers of the samples were chosen using a table of Sample Size for a Hypothesis Test of the Odds Ratio with significance level of α=0.05, statistical power of 1-β= 80%. Based on the table of Sample Size for a Hypothesis Test of the Odds Ratio, if P_2= 0.50 and OR=3.25, the numbers of subject research would be 54. This research implemented a ratio between case group and control group of 1:2, then the numbers of cases would be 54 samples and of controls 108 samples to match the total of 162 samples. The data on case samples in maternal mortality were taken from District of Brebes' Health Institutions, and the data on control subjects were taken from cohort registry and verbal autopsy documents at the Community Health Centre whereby a case of maternal mortality existed.

The technique in collecting the data was conducted based on the data taken from District of Brebes' Health Institutions. Then, the data were supported by cohort and verbal autopsy data from the Community Health Centres that had records on maternal mortality. To process and analyse the data, the researcher used a program of Stata 13. Quantitave data analysis was univariately completed in order to display the data in the form of frequency distributions of each variable, which would be decribed in frequency and percentage (Riwidikdo, 2010). Data analysis was completed using path analysis to understand the direct and indirect effects of independent variables to dependent variables. Path ana-

lysis was the technique used to cognise the effects of exogenous variables to endogenous variables either directly or indirectly.

RESULTS

Maternal mortality in 54 cases at District of Brebes, Central Java spreaded in 28 out of 36 within working areas of the Community Health Centres in District of Brebes. Based on the causes of maternal mortality in District of Brebes mostly were pre-eclampsia/ eclampsia (33.3%), and uterine atony (16.7 %).

Maternal mortality which was caused by indirect complications such as heart disease/ cardiac decompression was as much as 12.9%, suffocations (7.4%), uterine ruptures (5.5%), anemia, placental abruptions, uterine inversions, tuberculosis, leaky gut syndromes, asthma, hepatitis B, edema pulmo and *acute infark miocard* (each for 1.8 %).

Table 1. Frequency Distributions on the causes of maternal mortality in District of Brebes, Central Java 2016

No.	Causes of Maternal Mortality	n	%
1.	Direct Obstetric Complications		
	a. Bleeding		
	1) Uterine Atony	9	16.7
	2) Uterine Rupture	3	5.5
	3) Anemia	1	1.8
	4) Placental Abruption	1	1.8
	5) Uterine Inversion	1	1.8
	b. Preeclampsia/Eclampsia	18	33.3
	c. Postnatal Infection	4	7.4
2	Indirect Complications		
	a. Heart Diseases/ Cardiac Decompression	7	12.9
	b. Suffocation	4	7.4
	c. Tuberculosis	1	1.8
	d. Leaky Gut Syndrome	1	1.8
	e. Asthma	1	1.8
	f. Hepatitis B	1	1.8
	g. Edema Pulmo	1	1.8
	h. *Acute Infark Miocard*	1	1.8
	Total Numbers	54	100

Most maternal mortality in District of Brebes happened during postnatal periods were 39 cases (72.2%), during pregnancy periods were 12 cases (22.2%), and during labour were 3 cases (5.6%). Frequency distributions on maternal mortality in District of Brebes, Central Java is figured in Table 1. Maternal mortality in District of Brebes, Central Java mostly happened in hospitals with 42 cases (77.8%), 6 cases (11.1%) died on the way, 5 cases (9.2%) died at home and one case (1.8%) died at Community Health Centre. Case distribution on maternal mortality based on the place of death in District of Brebes is figured in Table 2.

Table 2. Case distribution on maternal mortality based on the place of death

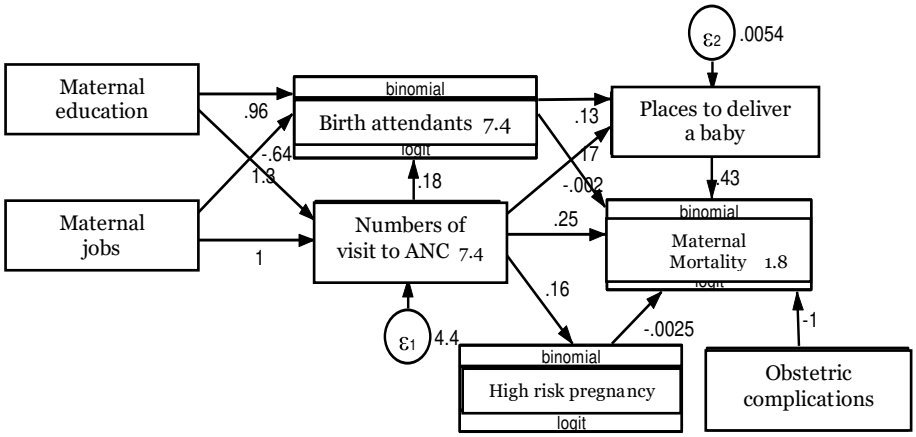
No.	Places of Death	n	%
1.	Home	5	9.2
2.	Community Health Centre	1	1.8
3.	Hospital	42	77.8
4.	On the way	6	11.1
Total Numbers		54	100

The lenght of care at a hospital before a mother died could be derived from the descriptions of health services on the reference. Among 54 cases mothers died at hospitals, 51.9% died less than 48 hours after being admitted to the hospitals. This might be caused by mothers' bad health conditions even before being taken to the hospitals, or by delays in handling those mothers' situations. Whereas mothers who died in hopitals in less than 48 hours after being admitted to the hopitals might happen because of the inadequate facilities such as availabilities of blood for transfusions in the hopitals in mountainous area like the areas of Salem, Sirampog, Paguyangan, and Bentar.

Table 3. Results on bivariate analysis between free variables and maternal mortality

No	Obstetric Complications	Cases		Controls		p
		n	%	n	%	
1	Contextual Determinants					
A	Maternal Education					
	University	5	9.26	24	22.22	<0.001
	Senior High School	5	9.26	43	39.81	
	Junior High School	18	33.33	6	5.55	
	Primary	26	48.14	33	30.55	
	Uneducated	0	0	2	1.85	
B	Maternal Jobs					
	Employed	12	22.22	55	50.93	<0.001
	Unemployed	42	77.88	53	49.07	
2	Intermediate Determinants					
A	Numbers of visit to ANC					
	≥ 4 times	51	94.40	108	100	0.002
	< 4 times	3	5.60	0	0	
B	Birth Attendant					
	Health Workers	46	85.19	108	100	<0.001
	Non-health workers	8	14.81	0	0	
C	Places to deliver a baby					
	Health Institutions	53	98.15	108	100	0.156
	Non-health Institutions	1	1.85	0	0	
3	Proximate Determinants					
A	High-Risk Pregnancy					
	Not High-risk/Low-risk	12	22.22	24	22.22	1.000
	High-risk	42	77.78	84	77.78	
B	Obstetric Complications					
	Without Complications	16	29.63	15	13.89	0.016
	With Complications	38	70.37	93	86.11	

The results on bivariate analysis in Table 3 indicated that what considered to be parts of contextual determinants, which were maternal education (p<0.001), maternal jobs (p<0.001), statistically showed that there was a significant corelations of p <0.05. What considered to be intermediate determinants that had significant correlations with maternal mortality were the numbers of visits to ANC (p= 0.002) and birth attendants (p<0.001). What considered to be parts of proximate determinant that had significant correlations with maternal mortality were obstetric complications (p= 0.016). Besides, there were some variables that did not have any correlations with maternal mortality. Those were places to deliver babies (p=0.156) and high-risk pregnancy (p=1.00).



Picture 1. Structural model of path analysis with estimate

Table 4. Results on path analysis between free variables and maternal mortality

Relationship between variables			b	CI 95% Lower Limit	CI 95% Upper Limit	p
Maternal Mortality	←	Numbers of visits to ANC < 4 kali	0.25	0.07	0.43	0.006
		Birth attendants Non-medical staffs	16.77	-1882	1915	0.986
		High-risk pregnancy	0.002	-0.92	0.92	0.996
		Obstetric complications With complications	0.99	-1.85	0.14	0.022
		Places to deliver a baby Non-medical institutions	0.43	-5785	5785	1.000
Constants			10.10	-3.40	0.28	<0.001
Birth attendants	←	Numbers of visits to ANC <4 kali	0.18	-0.97	0.41	0.203
Non-medical staff		Maternal education <Junior High School	0.96	0.04	1.88	0.041
		Maternal jobs Unemployed (Housewife)	1.32	-0.84	3.48	0.233
Constants			-7.36	-11.20	3.53	0.000
High-risk pregnancy	←	Numbers of visits to ANC <4 kali	0.16	-0.02	0.33	0.083
Constant			0.21	-0.99	1.41	0.735
Places to deliver a baby non-medical institution	←	Numbers of visits to ANC <4 kali	0.001	-0.007	0.003	0.443
		Birth attendants Non-medical staffs	0.13	0.07	0.18	0.00
Constants			0.01	-0.02	0.04	0.463
Numbers of visits to ANC	←	Maternal education <Junior High School	-0.63	-0.92	0.34	0.000
		Unemployed Mothers (housewife)	1.00	0.34	1.67	0.003
Constants			7.37	6.71	8.03	<0.001
Var (e. Places to deliver a baby)			0.005	0.004	0.006	
Var (e.Numbers of visits to ANC)			4.38	3.52	5.45	

The results of mutivariate analysis using logistic regression presented 4 independent variables that had correlations to maternal mortality. Those were maternal education, maternal jobs, numbers of visits to ANC and obstetric complications. The

results of the analysis using path analysis is figure in Table 4.

Data analysis using path analysis was intended to acknowledge the effects of independent variables to dependent variables either directly or indirectly, with results showing that the independents variables which affected directly on maternal mortality were the numbers of visits to ANC (b= 0.25; 95% CI= 0.07 to 0.43; p = 0.006) and obstetric complications (b= 0.99; 95% CI= -1.85 to 0.14; p= 0.022). Whereas maternal education also had effects on birth attendants and the numbers of visits to ANC, the variable of maternal jobs had effects on the numbers of visits to ANC, and maternal education to the choices on birth attendants.

DISCUSSION

1. Contextual Determinants

The risk factors that influenced maternal mortality as parts of the contextual determinants were:

a. Maternal Education

The results of bivariate analysis indicated that maternal education had significant correlation to maternal mortality (p< 0.001). The results of multivariate analysis with logistic regression showed that maternal education influenced maternal mortality (OR= 2.16; 95% CI= 1.45 to 3.20; p= 0.001). The results of multivariate analysis, the variable of maternal education had effects on the numbers of visits to ANC (b=-0.64; 95% CI= -0.92 to 0.36; p< 0.001). This means that the higher the education levels are, the more frequent it is for pregnant mothers to visit ANC. Maternal education levels also have effects on the elections of birth attendants. If a pregnant mother has a low level of education, she will have more tendency to choose a birth attendant who is not part of medical staffs (b= -0.86; 95% CI= 0.02 to 1.70; p= 0.04).

These research findings are in accordance with the previous one conducted by Hernandez and Moser (2013). They stated that there was a correlation between maternal education and maternal mortality. In addition to it, the results of multivariate analysis corresponds to the previous research conducted by Oedraogo, Baguiya, Millogo, Some dan Kouanda (2016), which stated that contextual determinants were indirectly influenced maternal mortality.

b. Maternal Jobs

The results of bivariate analysis indicated that maternal jobs had significant correlation to maternal mortality (p<0.001). The results of multivariate analysis with logistic regression indicated that maternal jobs had effects on maternal mortality (OR= 2.60; 95% CI= 1.06 to 6.28; p= 0.03). However, based on the results of multivariate analysis using path analysis, maternal jobs had effects on the numbers of visits to ANC (b= 1.00; 95% CI= 0.34 to 1.67; p= 0.003). This means that unemployed mothers will increase the numbers of visits to ANC. These research findings correspond to the previous research conducted by Sumarni (2014), which stated that employed mothers during pregnancy had significant correlations to maternal mortality but did not have any significant effects (Sumarni, 2014).

2. Intermediate Determinants

a. Numbers of Visits to ANC

The results of bivariate analysis indicated that the numbers of visits to ANC had significant correlations to maternal mortality (p= 0.002). The results of logistic multivariate analysis also influenced maternal mortality (OR= 1.45; 95% CI= 1.17 to 1.79; p= 0.001). The results of path analysis indicated that the numbers of visits to ANC had effects on maternal mortality (b= 0.25; 95% CI= 0.07 to 0.42; p= 0.006). This means that the numbers of visits to ANC <4 times will have more risks on maternal

mortality. This happens because of the cases of 94.4% on the numbers of visits to ANC which are more than 4 times, and of the controls of 100% mothers do the visits to ANC more than 4 times.

Those research results contradict to the previous research conducted by Adam, Wati dan Budiman (2014), which stated that the numbers of visits to ANC did not have any correlations with maternal mortality (Adam, Wati dan Budiman, 2015).

Access indicators to pregnant mothers are antenatal care service which are described in K1 (first contact) and K4 (the 4th contact) with medical staffs who are competent and in accordance with the standards applied. ANC services aim to fulfill the rights of every pregnant mother to obtain qualified antenatal services so as to be able to undergo healthy pregnancy periods, safe labour and giving births to healthy babies (Kemenkes RI, 2010).

b. Birth Attendants

The results of bivariate analysis indicated that the elections on birth attendants had significant effects (p<0.001), whereas the results of multivariate analysis on the elections of birth attendants did not have effects on maternal mortality. The results of multivariate analysis using path analysis indicated that the elections on birth attendants did not influence maternal mortality (b= 16.77; 95% CI= -1882.14 to 1915.68; p= 0.99). It means that birth attendants, either medical workers or not, will not influence maternal mortality.

This research result contradicts to the result of a previous research conducted by Lili and Megatsari (2014). They stated that birth attendants were very influencial to mothers and babies' safeties during labour. In 2015, Department of Health set a target of 95% labour to be assisted by medical workers (Lili dan Magatsari, 2015).

3. Proximate Determinants

a. Obstetric Complications

The results of bivariate analysis indicated that obstetric complications had effects on maternal mortality (p=0.016). On the results of multivariate analysis with logistic regression, obstetric complications also had effects, when put together with other variables, to maternal mortality (OR= 0.27; 95% CI= 0.10 to 0.73). The results on data analysis using path analysis also indicated that obstetric complications had effects on maternal mortality (b= 0.99; 95% CI=-1.85 to 0.14, p= 0.02). This means that mothers with obstetric complications will increase the rates on maternal mortality. In other words, based on the results of this research, mothers with obstetric complications have 0.99 times more risks to maternal mortality to those without.

These results are in accordance with the results of the previous research conducted by Almerie, Matar, Shahrour, Chamat, and Abdussalam (2010), which stated that obstetric complications had effects or had become the causes of maternal mortality.

Obstetric complications consist of complications during pregnancy, labour and postnatal periods that aggravate mothers' health conditions (Almerie, Matar, Shahrour, Chamat, dan Abdussalam, 2010). Some of the obstetric complications that had become the causes of maternal mortality in District of Brebes were preeclampsia and eclamsia (33.3%), postnatal bleeding caused by uterine atony (16.7%), postnatal infections (7.4%), uterine rupture (5.5%), anemia, placental abruption and uterine inversion, each was 1.8%.

Preeclampsia/ eclampsia are specific pregnancy syndroms characterised by the decrease of organ perfusions as in high blood pressure and proteinuria. Should they are not well anticipated, seizures will happen to pregnant mothers, during labour

or postnatal period which will increase the rates of maternal mortality (Jakarta Service Medical, 2013).

Postnatal complications, especially sudden acute bleedings, will cause mothers to lose lots of blood and lead to maternal mortality in short periods of time. (Fibriana, 2007).

Based on the results on a previous research conducted by Mukasa et al., (2013) uterine rupture or torn uterus was a prime ostetrical complication whose symptoms must be soon recognised and treated by medical workers. Uteri rupture was one of the indicators to recognise the incompetence of midwivery and health institutions in a region (Mukasa, Kabakyenga, Senkungu, Nganzi, Kyalimpa and Roosmalen, 2013).

Based on this research findings on the risk factors that influence maternal mortality in District of Brebes, it can be concluded that the risk factors that influence maternal mortality either directly or indirectly are:

1. Direct Effects on Maternal Mortality

a. Numbers of Visits to ANC

Mothers with the numbers of visits to ANC <4 times will have more risks to maternal mortality (b=0.25; CI 95%= 0.07 to 0.42; p = 0.006).

b. Obstetric Complications

Mothers with obstetric complications have more risks to maternal mortality (b=-0.99; CI 95%= -1.85 to 0.14; p= 0.022)

2. Indirect Effects on Maternal Mortality

a. Maternal Education <Junior High School will tend to choose birth attendants who are not medical workers (b= -0.86; 95% CI= 0.02 to 1.70; p= 0.041).
b. Maternal Education <Junior High School will reduce the numbers of visits to ANC (b= -0.63; 95% CI= -0.91 to 0.35; p< 0.001).
c. Maternal jobs to the numbers of visits to ANC (b= 1.00; 95% CI= 0.34 to 1.66; p= 0.003).

It is expected that the results of this research can be parts of suggestions for:

1. Health Institutions in District of Brebes

Constant and regular assessments on the competence of midwives and doctors who give emergency maternal treatments are performed either in the level of basic medical service or as references. Adding more of competent medical workers (gynaecologist) and completing hospitals facilities including supplying blood for transfusions in moutainous areas with regards of the road access to the central district which is taken a long time ($\pm$ 2 jam), are necessities. Based on the excisting data, there are 77.8% mothers died in hospitals.

2. Community Health Centres in District of Brebes

It is expected for medical workers to increase their knowledge and skills in recognising the critical signs and obstetric complications as well as in treating obstetric emergencies. It is expected for community health centres to help the community and families to increase their knowledge on critical symptoms in pregnancies by involving the members of the families in the implementations of integrated ANC.

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